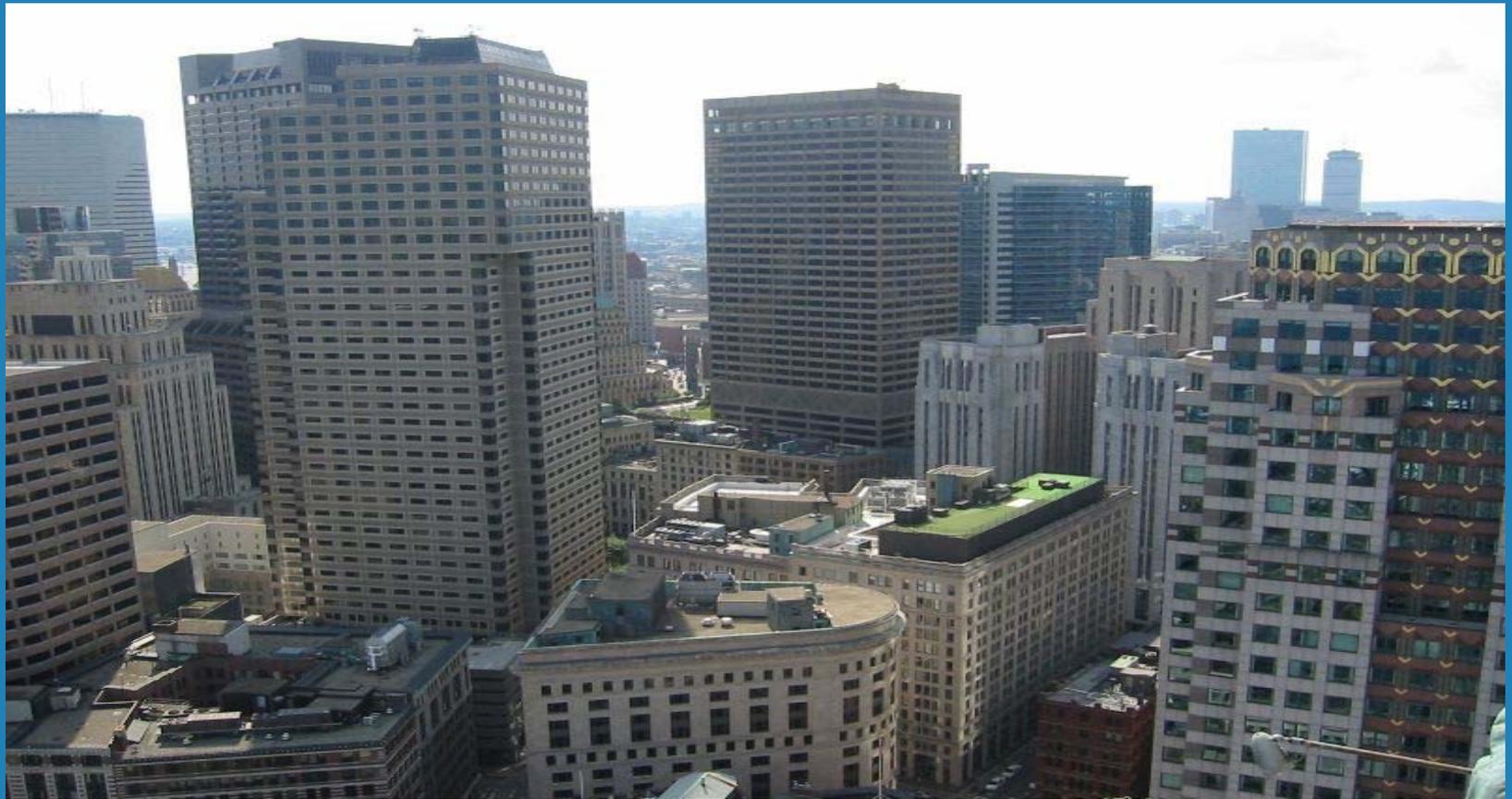
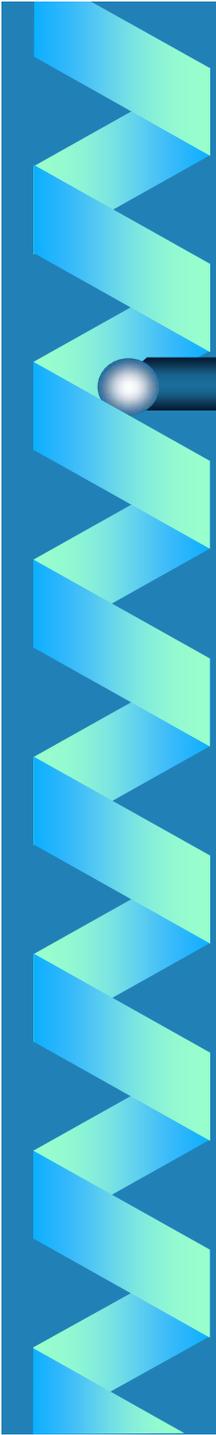


Division of Capital Asset Management Preventative Maintenance Guidelines for Roofs





Effective Roof Asset Management

- While it is not difficult to maintain roofs properly, it does require commitment and a certain level of expertise. Inspections and routine maintenance cannot be deferred, even if funding is tight and staffing levels low. Those who are conducting the inspections and performing the maintenance must be qualified. If the organization does not have the in-house expertise, then it must look for outside help, even though doing so may increase program costs.

Effective Roof Asset Management

- Regular maintenance is a key ingredient in the long-term performance of any roof.
- A comprehensive roof maintenance program will minimize the need for emergency repairs, reduce damage to the building structure and finishes, and help maintain a safe and healthy working environment for building occupants.
- Many in the industry believe estimates that for every \$1 spent on a comprehensive roof maintenance program, \$5 is saved through reduced emergency repairs, interior damage, energy conservation and extended roof life.



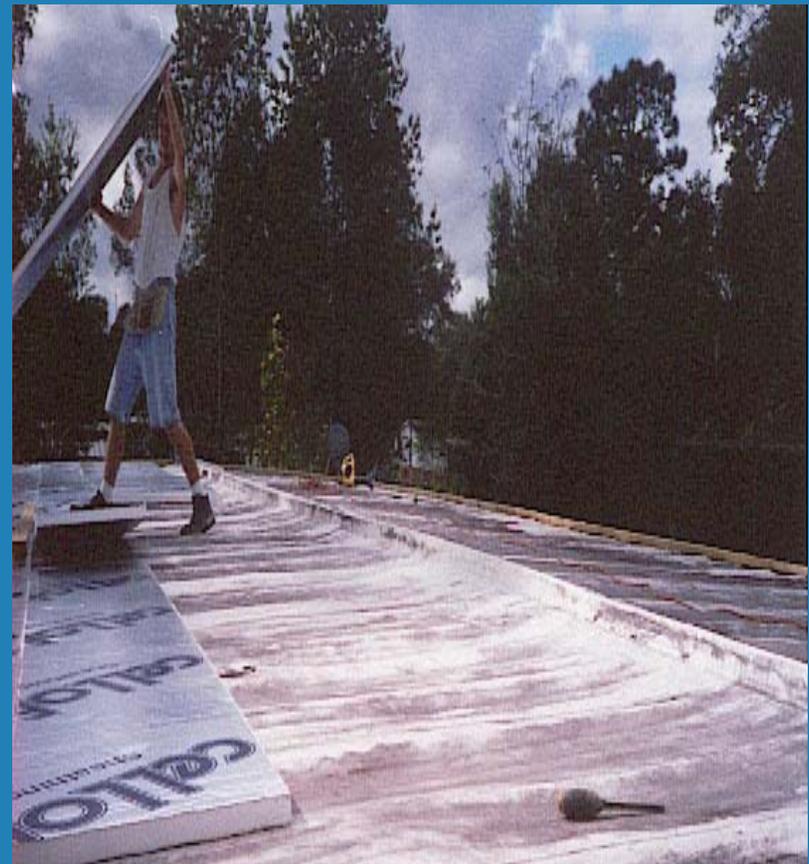
Effective Roof Asset Management



- There are two major components in all roofing maintenance programs: inspections and repairs.
- While all roofing programs have these two elements, what is included in each of the elements depends on the type of roof, the climate where the building is located and how building operations affect the roof.
- Built-up roofs have different inspection and maintenance requirements than single-ply roofs. Cold climates subject roofs to different stresses than warm climates.
- Buildings where access to the roof is severely limited will have different inspection and maintenance requirements than those with high levels of roof traffic.

Roof Inspections

- Three different types of roof inspections must be performed: the initial inspection, the seasonal inspection and the damage inspection.
- The initial inspection verifies that the roof has been properly installed and is free of defects. It identifies where equipment was installed on the roof and ensures that the equipment has been installed in such a way that its operation will not damage the roof.
- It also records the location of any other roof penetration for future monitoring, as well as ensuring that the roof is properly sealed around the penetrations. Initial inspections are generally performed when the building is first turned over to the owner or immediately following a roof replacement project.



Roof Inspections



- Seasonal inspections should be performed twice each year, in the fall and in the spring. The timing of these inspections is important. The fall inspection is designed to identify defects that may have formed over the summer when the roof was exposed to high thermal stresses and ultraviolet light. The spring inspection looks for problems that may have been caused by ice or snow accumulation, or damage from the wind.
- Inspections should be performed late enough that the season's most severe weather has already passed, but early enough so that roof repairs can be completed before weather conditions interfere.

Roof Inspections

- Damage inspections are performed immediately following severe weather, such as wind storms or hail storms. They also should be performed whenever a change is made to the equipment installed on the roof. For example, if a compressor or other heavy piece of equipment is replaced in a rooftop unit, it is good practice to inspect the roof for damage afterwards. Even something as simple as a dropped tool can damage a roof membrane.







Ponding Water Inspections

- ☼ Another cause of roof damage is ponded water on the roof's surface. Water can accelerate the breakdown of some roofing materials. The weight of the water can compress roof insulation, producing low spots in the roof's surface. Water collects in these depressions, further compressing the insulation.
- ☼ The spring and fall roof inspections should be conducted within 24 to 48 hours of rainfall. The roof surface at that time should be free of ponding. If not, inspect all roof drains to ensure they are free of debris and flowing properly. If the drains are functioning properly and there is ponding, check for visible changes in the roof's surface elevation.



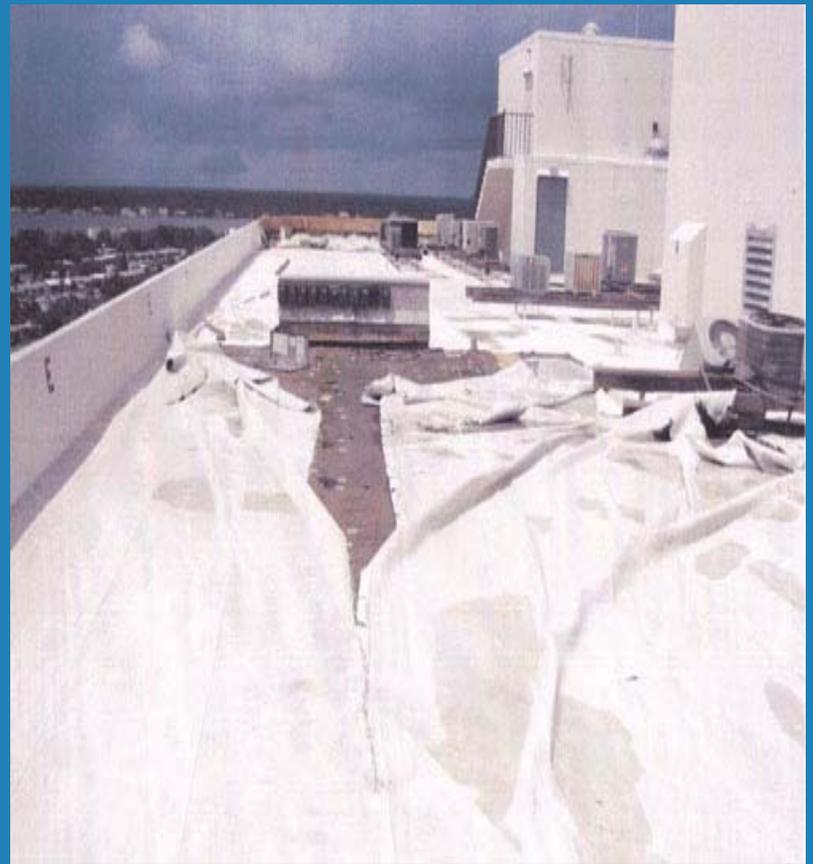
Ponding Water Repairs



- For single-ply roofing, it may be possible to correct the elevation by adding a new membrane to the existing one. For other roof types, or if the deflection is too great, it will be necessary to replace the roof membrane and insulation in those areas where ponding is a problem..
- Another way to eliminate a ponded area is to install a siphon drainage system. The siphon drainage system is a pump or a set of pumps placed in the lowest point of the ponded area. When the ponded area reaches a certain depth, the pump activates until the drainage line is primed and siphoning takes over. The drainage lines should be run from the pump into an existing roof drain, gutter or simply over the edge of the roof.

Wind Damage Inspections

- High winds can damage roof membranes by causing them to separate along seams and from roof flashings. Wind-blown branches can rip or poke holes in the membrane. Pieces of equipment located on the roof can be torn loose, puncturing or tearing the membrane. Ballast can be displaced by high wind, exposing the roof's membrane to wind uplift or damage from the sun's ultraviolet rays.
- Inspections for wind damage should be conducted in the spring and fall, and after any major storm. For ballasted roofs, look for areas with missing ballast. For unballasted roofs, look for stressed seams and fasteners. If debris is found on the roof, inspect for damage to the membrane. Check all equipment on the roof to make certain that access panels and other components are properly fastened.



Chemical Damage

- ❁ Single-ply roofing materials can undergo chemical changes that reduce their strength as a result of contact with a wide range of organic substances. While some of the substances are deposited on the roof from the atmosphere, damage is more likely to be caused by a building discharge vent that exhausts oils, fats or other organic solvents.
- ❁ Look closely at the roof surface near the discharge from building exhausts, particularly those that serve kitchens. Look for buckling or changes in the color and consistency of the roof membrane. In extreme cases, the membrane may be cracked. Damaged membranes should be replaced.



Chemical Damage



- The best way to prevent damage from contaminants is to redirect all building exhausts away from the roof surface. If redirection cannot eliminate the exposure, add a layer of protective material — light weight concrete pavers, for example — over the roof membrane.
- Inspections for chemical exposure should be conducted when the roof is new. By redirecting exhaust or installing a protective layer, damage to the roof membrane can be prevented. Additional inspections should be performed whenever changes are made to the building's mechanical systems that may result in new discharges onto the roof surface.

Inspect Seams

- An additional item to be inspected on single-ply roofs is membrane seams. Seams are a particularly high stress point in single-ply roofs. As changes take place in the membrane, shrinking and movement will cause stresses to accumulate at the seams, resulting in splits and seam failures.
- Inspect all seams for splits and open areas. Also inspect areas where the membrane changes direction or intersects with flashing and equipment curbs. Look for open areas, splits, bubbles and changes in the membrane color.
- All damaged areas along seams must be repaired according to the roofing manufacturer's requirements.



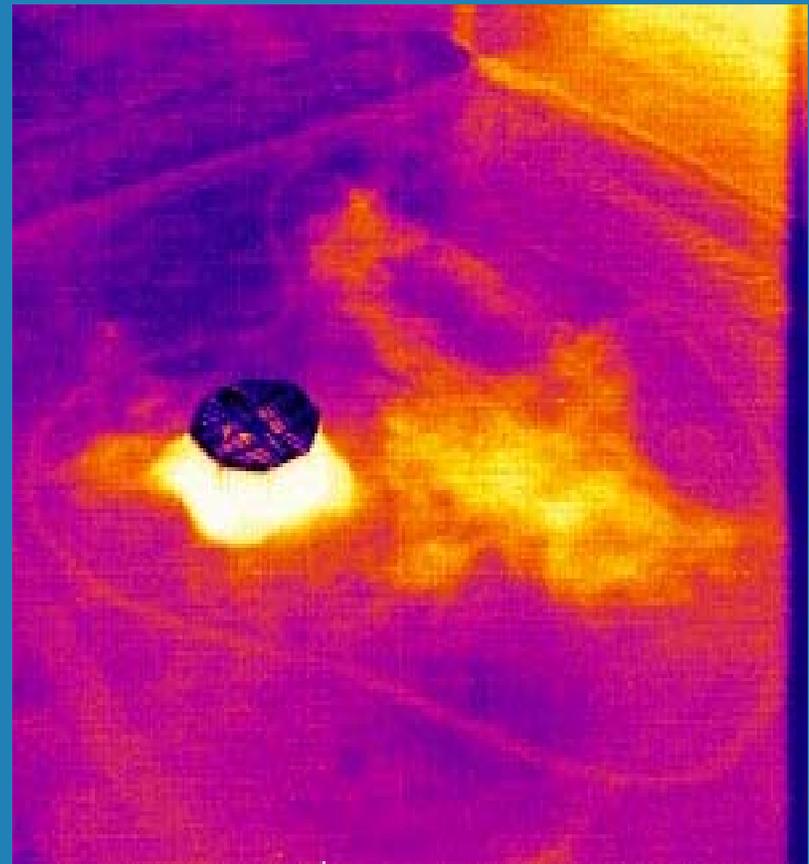
Exterior Inspections



- Even with regular inspections and repairs, water can penetrate the membrane, damaging the insulation and possibly interior surfaces. That's why it is important that the spring and fall roof inspections include checks for water damage both within the roofing materials and within the building.
- Start by walking the roof, checking for insulation that feels soft or spongy underfoot. Both are an indication that water has penetrated the roofing membrane and made its way into the insulation.

Exterior Inspection

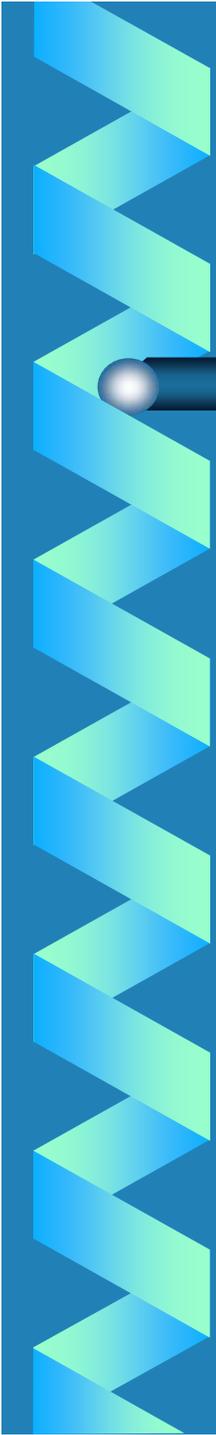
- If water damage to the insulation is suspected, conduct a roof moisture survey using an infrared imager, nuclear backscatter meter or electrical capacitance meter. These instruments can detect moisture in insulation without damaging the insulation or the membrane. Wet insulation should be removed and replaced to prevent damage to the deck or the building's interior. Even if no suspect areas are detected, it is good practice to conduct the roof moisture survey once every four or five years.



Interior Inspection



- Inspect the ceiling and all walls on the upper floor of the building for signs of water damage. Areas most likely to bear marks of damage are those located below any roof penetration, including mechanical equipment, piping, drain lines and skylights. Check these areas closely for staining and discoloration.
- If evidence of water damage is found, check the roof areas above and close to the damage. Look for damaged or loose flashings, broken seals around mechanical equipment and pipes, deteriorated parapet walls, and wet roof insulation. All defects should be repaired as quickly as possible and the adjacent insulation tested for moisture.



Roof Assembly Historical Record

- Building owners should maintain historical records of their roof assemblies. A historical record will provide an owner with data concerning the original roof installation, such as the roof plan (sketch), system type, contractor who installed the roof assembly, panel manufacturer, warranty information, any special conditions (such as a retrofit roof assembly) or any known contaminants that may be discharged onto the roof surface. An owner also should use the historical record to document all subsequent inspections, maintenance and repairs performed on the roof assembly since its installation. This information should minimize the cost of repair and maintenance work.

Roof Repairs

- ⦿ If potential problems are noted during inspections or in the course of routine maintenance work performed by the owner, or evidence of a leak is observed, a professional roofing contractor should be contacted to perform repairs. If the roof system is covered by a contractor's or manufacturer's warranty, notify the contractor and/or manufacturer immediately. Work above and beyond that described herein may void existing warranties and/or damage the roof through the use of incompatible or inappropriate materials or methods.

Owner Maintenance Responsibilities

- Certain maintenance can be accomplished by the building owner's maintenance personnel. Examples are:
- Pick up and dispose of debris such as nails, bottles, cans, balls, boards or tree limbs. Call a professional roofing contractor to repair apparent damage or if vegetation has roots extending into the roof membrane.
- Keep drains, gutters and scuppers clear. With proper precautions against damaging the roof and drainage system, clogged drains may be cleared with a "snake." Use deicing salt to melt ice clogging drains.



Owner Maintenance Responsibilities

- Trim back tree limbs so that they terminate a few feet outside the roof edge.
- Repair loose/broken rooftop equipment or accessories if qualified.
- Using a push broom, redistribute aggregate surfacing back over roof membranes that has been displaced by wind or water flow.
- If duct work is suspected to be the cause of a roof leak, the building owner should contact a mechanical contractor to access the duct work's watertight integrity and recommend repair procedures.



Emergency Repairs

- Emergency repairs may be required after severe weather. In the event that a professional roofing contractor is not readily available, and to minimize damage to the interior finishes and contents, the building owner may elect to perform emergency repairs. These repairs are temporary. Permanent repairs should be made by a professional roofing contractor as soon as weather permits.
- If the roof is under warranty, the warrantor should be contacted as soon as possible.
- Different types of roofs require varied materials and procedures to make emergency repairs.
- Review manufacturer's literature for products and procedures recommended for emergency repairs.



Emergency Repairs



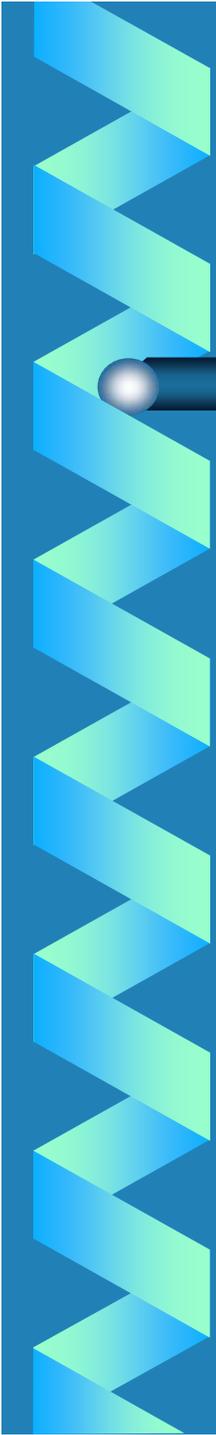
- Protect the interior. Control the spread of water in the interior by collecting the water in containers or by using plastic sheeting to protect the building contents.
- Remove excess water from the roof. Check roof drains and scuppers to be certain that they are functional. Excess ponding may cause additional damage or collapse. Be cautious of suction when removing debris from drains.
- Locate the source of the leak. Find the point on the roof surface above the area of leakage inside. Next check the condition of the rooftop mechanical equipment, then check all flashings at terminations and penetrations. If the system is aggregate surfaced, sweep the loose aggregate from the immediate leak area, then check the surface for splits or punctures.
- Perform emergency repairs using materials and procedures least damaging to the roof membrane. (See chart next slide)

Temporary Emergency Repair Material

Type of Roof	Temporary, Emergency Repair Material								
	Suggested Application (W - Wet) (D - Dry) (N/R - Not Recommended)								
	Plastic Cement	Sealants	Roof Tapes	Bentonite Clay	Self-Adher Membrane	Elastomer Coating	Wood Block		
Ballasted Loose Laid Single Ply	N/R	D	D	W	N/R	N/R	W or D		
Mechanically Attached Single Ply	N/R	D	D	W	N/R	N/R	W or D if possible		
Adhered Single-Ply	N/R	D	D	W	N/R	N/R	N/R		
Modified Bitumen	W or D	D	D	W	N/R	N/R	N/R		
Low Sloped Metal Panel Smooth	W or D	D	D	N/R	D	D	N/R		
Low Sloped Metal Panel Ribbed	W or D	D	D	N/R	D	D	N/R		
Steep Sloped Metal Panel Smooth	W or D	D	D	N/R	D	D	N/R		
Steep Sloped Metal Panel Ribbed	W or D	D	D	N/R	D	D	N/R		
Spray Polyurethane Foam Granules	N/R	D	N/R	W	N/R	N/R	N/R		
Spray Polyurethane Foam Coated	N/R	D	D	W	D	N/R	N/R		
Spray Polyurethane Foam Ballast	N/R	D	D	W	D	N/R	N/R		
Built Up Modified Bitumen Aggregate	W or D	D	N/R	W	N/R	N/R	N/R		
Built Up Modified Bitumen Mineral/Smooth	W or D	D	D	W	D	N/R	N/R		

Summary of Owner's Responsibility

- **The building owner can have a significant impact on the service life of any roof by committing to care for the roof. In order to properly care for the roof, an owner should:**
 - Maintain Historical Records
 - Control Roof Access
 - Conduct semiannual inspections and special inspections
 - Report leaks or roof damage immediately
 - Ensure routine maintenance
 - Use professional roofing contractors for major maintenance (e.g, recoating), emergency repairs (when possible) and permanent repairs.



Conclusions

- ❁ To be effective, roof maintenance programs require ongoing commitment — a commitment for funding to initiate the program, particularly if roofs have been neglected in the past, and a commitment for staffing to conduct the inspections and perform the repairs. But as the program develops, and roofs are brought up to standards, facility executives will find that their total roofing costs will decline. It will take patience and, above all, commitment. Without commitment, inspections and repairs will be deferred, and the roofing maintenance program will once again become reactive.

